

Biodigester Feasibility & Design for Space & Earth Project

Center Independent Research & Developments: JSC IRAD Program | Mission Support Directorate (MSD)



ABSTRACT

Biodigesters harness and utilize byproducts, and are a valuable technology for waste conversion and advanced exploration closed loops targets (6.1.a-E), including that of human waste. On Mars and at JSC, this could lead to growing food and to more sustainable uses of waste. It is critical to understand biogas generation rates, odor management of the effluent, and nutrient viability. Improved efficiency and reliance on this renewable energy source can become feasible for deep space missions.

ANTICIPATED BENEFITS

To NASA unfunded & planned missions:

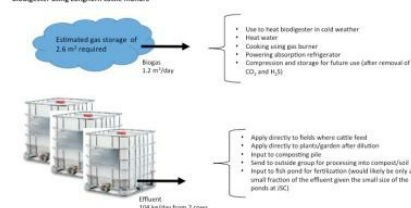
NASA plans to send humans to Mars in the 2030s. Changing waste management from current disposal techniques to asset and value-added techniques will promote the colonization and capacity of humans to be closer to production of energy independent of Earth.

DETAILED DESCRIPTION

Biodigesters support energy development mission goals and are a viable means of waste-to-fertilizer conversion. Advanced exploration will necessitate closing input/output loops, including that of human waste. Biodigesters harness waste and utilize byproducts. On Mars, this could lead to growing food, and to more sustainable uses of waste at JSC. It will also be a study in the efficiency comparison of other methane producing and waste-to-energy conversions, such as those using the Sabatier Reaction.

Calculating the process details and building a model for capturing the potential energy, nutrients, and gases produced from anaerobic digestion will demonstrate the usefulness of this technology for both space and Earth applications.

Biodigester using Longhorn cattle manure

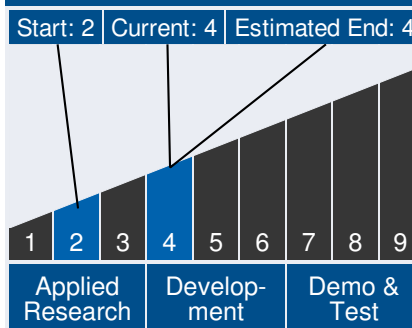


Inputs and Outputs, Anaerobic Digestion

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Technology Maturity



Management Team

Program Director:

- Douglas Terrier

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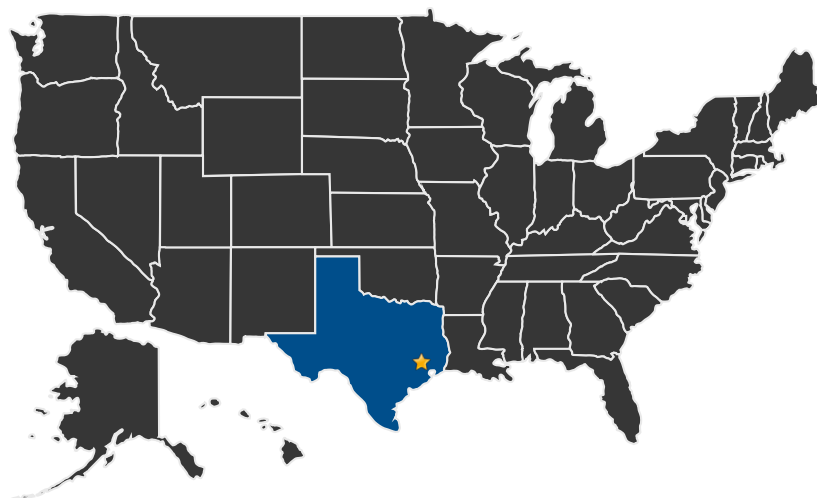
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Implementation requires hazard analyses, gas calculations, conceptual design specifications, operational sequences, and flow diagrams. The value of gases and fertilizer produced will contribute to future coupling with energy and plant growth systems. The Longhorn manure available is the potential test product that will be used in a JSC biodigester once environmental and safety approvals are attained.

U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States
With Work

★ **Lead Center:**
Johnson Space Center

Contributing Partners:

- Engineers Without Borders

Management Team (cont.)

Program Executive:

- Douglas Terrier

Program Manager:

- Ronald Clayton

Principal Investigator:

- Stacy Shutts

Co-Investigators:

- John Bacon
- Michael Ewert
- Thomas Paul

Technology Areas

Primary Technology Area:

Human Health, Life Support, and Habitation Systems (TA 6)

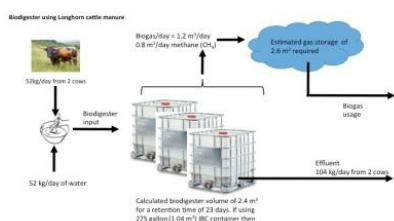
- └ Environmental Control and Life Support Systems and Habitation Systems (TA 6.1)
 - └ Waste Management (TA 6.1.3)

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IMAGE GALLERY



Inputs and Outputs, Anaerobic Digestion

DETAILS FOR TECHNOLOGY 1

Technology Title

Biodigester

Technology Description

This technology is categorized as a hardware system for other applications

An anaerobic digester produces methane gas and nutrient rich fertilizer from organic material "waste" via a four-stage process: bacterial hydrolysis, acidogenesis, acetogenesis, and methanogenesis. It has been understood for centuries that organic matter naturally decomposes and, in an anaerobic environment, produce gases. The ability to utilize this natural process in space could result in energy produced from what is currently disposed waste. Utilizing an anaerobic digester at the Johnson Space Center is an opportunity to practice and test producing and maximizing the efficiency of the gas and fertilizer byproducts.

Capabilities Provided

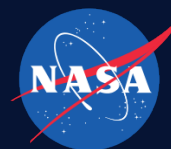
Waste will be processed via anaerobic digestion. The demonstration and investigation will provide further comparison of other models and means of producing methane, including number of inputs, safety, and conversion rate of organic matter to useful byproducts.

Potential Applications

The use of human waste, decomposable packaging, and crop residues, and other organic "trash" can be broken down and used in the biogas digester.

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Performance Metrics

Metric	Unit	Quantity
>50% methane production	%	50